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REVISION OF THE INTERNATIONAL ELECTRICAL UNITS

E. C. Crittenden, chief of the bureau's electrical division, sailed on January 13 to attend the third biennial meeting of the advisory committee on electricity and photometry established by the International Committee on Weights and Measures. The meeting opened on January 31 at the International Bureau of Weights and Measures which is located at Sevres, near Paris.

The international committee has undertaken to revise the present international electrical units. It proposes to base the units directly upon absolute measurements in the electromagnetic centimeter-gram-second system, instead of defining them by means of the mercury-ohm tube and the silver voltameter. Redeterminations of the ohm and ampere by absolute measurements are in progress in several national standardizing laboratories, including the Bureau of Standards; at the present meeting plans are being made for comparing the results found in different countries and for furnishing to all countries standards based upon the combined results.

The international committee likewise hopes to establish uniform units and standards throughout the world for the measurement of light. In this attempt it is collaborating with the International Commission on Illumination. A special committee on units and standards appointed by the latter commission, and consisting of representatives of France, Germany, Great Britain, Japan, the Netherlands, and the United States, met in Paris on January 30 to prepare recommendations on photometry for the official advisory committee.

The bureau has proposed the establishment of a system of photometric units based primarily upon the intensity of the light given by a "black body" radiator at the freezing point of platinum. (See TECHNICAL NEWS BULLETIN No. 151, November, 1929, and No. 170, June, 1931.) The adoption of such a basic unit must be supplemented by agreement upon a method for measuring lights differing from that of the basic standard in color. The flicker photometer, with proper allowance for the characteristics of individual observers, affords one of the most simple and practical

methods for making such measurements. Its use has, however, not been viewed with favor abroad. Consequently, a basis for international agreement is being sought in spectrophotometric measurements of colored filters, from which standard values for transmission of visible light can be calculated by means of "visibility factors" which have already been accepted by the International Commission on Illumination.

In both of these projects the National Physical Laboratory of Great Britain and the Bureau of Standards have been cooperating. Mr. Crittenden therefore visited London on his way to Paris in order to compare experimental results found at the bureau with those of the British laboratory. These two laboratories have joined in proposing that the new units in electricity and in light be put into general use on January 1, 1935. An alternative proposal is that their introduction be deferred until 1937. The most important duties of the 1933 meeting are to choose between these dates and to agree upon a definite schedule for carrying out the series of comparisons and interchange of standards which will be necessary.

COMPARISON OF QUARTZ AND STEEL END STANDARDS

The comparison of an end standard of fused quartz with one of steel is difficult because of the great difference in thermal expansion. Apparatus for making such a comparison has been constructed at the bureau. The apparatus may be kept in a small inclosed chamber where the temperature is regulated, and measurements made by the operator on the outside. The difference in length is measured by a very small electric motor. The screw is automatically stopped by breaking the electric circuit of a small electromagnetic clutch, when a definite measuring pressure on the end standard is reached. This is accomplished by forcing apart a pair of platinum contacts which are normally held together by a spring. The sensitivity is such that settings can be repeated to one-tenth micron or four-millionths of an inch.

A number of measurements have been made to determine the length of a spherical-ended quartz rod approximately 280 mm long by comparison with different combinations of flat-ended steel gages wrung together. The maximum difference of a single measurement from the mean was 1 part in 1,000,000.

The apparatus will be described more completely in Research Paper No. 528 in the February number of the Bureau of Standards Journal of Research.

RECOMPARISON OF PRIMARY STANDARDS OF RADIATION

During the past month an examination has been made into the status of the bureau's primary standards of radiation, copies of which are issued to biologists, botanists, photochemists, physicists, physiologists, etc., who desire to equate their radiation stimuli in absolute value.

These standards of radiation consist of 50-watt, 115-volt, anchored carbon-filament incandescent lamps which have been seasoned and calibrated for voltage and current in accordance with the accepted procedure in preparing similar standards of luminous intensity.

The first standards of radiation were obtained in 1913 by direct comparison of a group of lamps against a black body, and subsequent standards were obtained by comparison with this first group of lamps.

The present inquiry was prompted by a published report that copies of these standards deteriorate in radiant flux at the rate of 0.5 per cent per hour, which is contrary to all previous experience in the use of such lamps as standards of luminous intensity and as standards of radiation.

In 1918 an intercomparison of 6 of these radiation standards showed a deviation of 0 to 3 parts in 1,000 from the values of the radiant flux assigned to each lamp in 1913, which deviation is entirely within experimental errors.

In 1930 an intercomparison of 9 primary standards of radiation, including 3 of the originals (of 1913) which had not been used for 12 years, showed a maximum deviation of 3 parts in 1,000; again entirely within experimental errors, and none differing systematically from the intercomparison of 1918.

On recalling the three lamps that were reported to be deteriorating in radiant flux, one was reported destroyed by arcing in the socket.

The second lamp, which was reported to have deteriorated in radiant flux to the extent of 3.1 per cent in 9 hours, was found unchanged to less than 3 parts in 1,000. Similarly, tests with a potentiometer showed no changes in the volt-ampere calibration.

The third lamp of this group was found to have increased (instead of decreased) in radiant flux by almost 1 per cent, caused apparently by a hot spot in the filament, which appeared much brighter (hotter) than the rest of the filament on continuous operation. On closing the circuit momentarily this spot became red hot before the rest of the filament began to glow. Whether this injury in the filament occurred in shipment is unknown.

The conclusion of this inquiry is that there is no appreciable deterioration in the standards of radiation issued by the bureau, though unavoidably some may become defective. In a life test now in progress, on a standard of radiation, after operating it 176 hours the radiant flux has decreased by less than 3 parts in 1,000 from the value observed at the beginning.

ELIMINATION OF BACKGROUND NOISE IN SENSITIVE PULSE AMPLIFIERS

The recent development of vacuum tube amplifiers for the study of the ionization currents produced by separate alpha-particles and H-particles has led to the construction of instruments so sensitive that small fluctuations in various parts of the circuit which, in ordinary amplifiers are of no significance, become very troublesome because they are increased along with the ionization currents under observation. Most of this disturbance or "noise" arises in the initial stages of the amplifier, and attempts hitherto made to solve this problem have dealt chiefly with these stages. Recently there has been devised at the bureau a modification of the output stage, which makes it possible to suppress this noise without interfering seriously with the pulses produced by the ionization current. It is customary to record these pulses by means of an oscillograph connected to the output stage. With the modified arrangement much more distinct records can be obtained than was possible with previous arrangements. A complete description of this improvement will be published as Research Paper No. 522 in the February number of the Bureau of Standards Journal of Research.

IMPROVEMENT IN GEIGER-MÜLLER COUNTERS

In a study of Geiger-Müller tube counters used in counting cosmic ray particles, it has been found that the rate of counting is decreased when the

temperature is increased. This indicates that the density of the gas in the sealed counter has increased. Since this can only occur through the evaporation of material inside the counter which is normally solid or liquid at lower temperatures, an investigation has been made to determine the source of this vapor. About the only volatile material in the usual form of the counter is the hard-rubber bushings used to support the wire mounted axially in the tube of the counter. A form of counter has been devised at the bureau which eliminates the use of hard rubber, using glass tubes sealed into each end of the copper tube of the counter to support the ends of the wire. In this form of the counter no change of the counting rate occurs as the temperature is changed. This improvement eliminates the necessity for maintaining the counters at a constant temperature.

The description of this device will be published as Research Paper No. 526 in the February number of the Bureau of Standards Journal of Research.

OPERATION OF THICK WALLED X-RAY TUBES ON RECTIFIED POTENTIALS

In the study of X rays at the bureau it has been found that thick-walled glass, deep therapy X-ray tubes do not reach a steady state within the first few minutes of operation on some types of generator. All thin-walled tubes tried thus far quickly reach a steady operation state. Depending upon the mode of control of the generator, the X-ray emission of a thick tube may increase or decrease by 10 to 20 per cent on mechanical or valve tube rectifiers and not reach a steady state until some 10 minutes after starting. The change in X-ray emission between the second and tenth minute of operation appears to depend upon the electrical regulation of the transformer. Cooling of the tube walls with strong air blasts delays the attainment of the steady state but does not affect the magnitude of the ret change in emission. For some generators the output remains steady if the effective tube current and voltage be maintained constant. A qualitative explanation of the effect is based on the blocking action of the high negative charge on the glass walls when the tube is cold. As the tube warms up this charge is dissipated through the increased electrical conductivity of the glass. The influence of this effect upon dosage meas-

urements is discussed in Research Paper No. 527, which will be published in the Bureau of Standards Journal of Research for February, 1933. The effect is absent when the tube is operated on sources of potential which are nearly free from ripple.

THE MECHANISM OF HYPERSENSITIZATION OF PHOTOGRAPHIC EMULSIONS

It has long been known empirically that photographic sensitization by dyes could be improved by the addition of ammonia to the dye bath, or by bathing finished plates containing dyes with solutions of ammonia or ammonia plus silver salts. The characteristic improvement made by "hyperm sensitization" is a selective increase in sensitivity for the longer wave lengths; that is, for the region of sensitivity conferred by the dye as contrasted to the short wave-length sensitivity of pure silver salts. The results of ammonia treatment vary considerably with the emulsion treated, being especially dependent on the dye used for sensitizing; data on treatment of commercial panchromatic emulsions show that in many cases it is better to use pure water instead of ammonia, as the increase in sensitivity is almost as great and the stability is greater while the fog is less.

An explanation of the action of ammonia has been found at the bureau and will be published as Research Paper No. 525 in the Bureau of Standards Journal of Research for February, 1933. It has been shown that when a photographic emulsion is bathed in a solution there is set up a membrane equilibrium governed by the well-known Donnan equation, this being confirmed by measurements of the equilibrium of emulsions with ammonia solutions. The consequence of bathing the emulsion with ammonia and drying is to leave it with an excess of silver over halogen. The equilibrium theory was further confirmed by chemical analysis of plates bathed under practical conditions, and of the ammonia baths, showing the excess of silver in the plate and of bromide in the bath.

Photographic data on the effect of ammonia on sensitization by known dyes are presented for comparison with the corresponding data in a previous paper (RP488) on the effect of soluble silver salts in the emulsion on sensitization by the same dyes. The silver salts produced the same type of hypersensitization as the ammonia; furthermore, ammonia produces hypersensitization only when the dye

sensitizes more effectively on addition of silver salts. Other theories of hypersensitization are briefly discussed and shown to fail to correspond to the facts, while the excess of silver left in the emulsion by the ammonia treatment accounts satisfactorily for the photographic effects. Some hypersensitization can also be produced by certain reducing agents, but this is not involved in the usual ammonia process.

SATURATION SCALE FOR YELLOW COLORS

The relationship between colorimetric purity of the stimulus and saturation of the color evoked under specified observing conditions has been determined at the bureau for yellow colors by using the yellow series of Lovibond glasses. Two observers have selected glasses from this series requisite to produce a scale progressing by equal steps from white to yellow. These results have been compared with previous experimental results, and with two empirical relations. Glasses representing the four scales compared have been grouped together and judgments obtained from eight observers as to which group formed the most satisfactory scale, with the result that the new experimental scale has been corroborated. This information is useful in developing a method of writing uniform color tolerances.

SOME IMPROVEMENTS IN PSYCHROMETRY

Air humidity is generally measured by noting the reading of a thermometer having a bulb incased in wetted cloth, and simultaneously measuring the temperature of the air with an ordinary thermometer. From the two readings so obtained, the air humidity can be found by means of a table or chart. This combination of a wet-bulb and a dry-bulb thermometer is called a psychrometer.

With proper care in its use, the psychrometer will give rather accurate values of humidity under normal weather conditions. However, when it is either very hot or cold, or very dry or wet, rather large errors occur despite the best of care. The instrument simply does not function correctly under such conditions.

By slightly modifying the conventional ventilated psychrometer, the Bureau of Standards has found it possible to correct these errors; the resulting instrument is quite accurate at all humidities up to 90 per cent and up to at least 150° F. air temperature.

In studying the instrument, it was also tested and found accurate under reduced air pressures equivalent to altitudes up to 32,500 feet.

A new chart for obtaining either relative or absolute humidity from the psychrometer readings has been developed. This chart is both simpler to use and more accurate than those previously available. It has not, however, been published by the bureau, but will appear later in the Journal of the Washington Academy of Sciences.

REFERENCE TABLES FOR PLATINUM TO PLATINUM-RHODIUM THERMO-COUPLES

Thermoelectric thermometers made of platinum and platinum-rhodium alloys are extensively used for high-temperature measurements. Such instruments are usually calibrated at a number of known temperatures which can easily be reproduced, such as the melting points of various pure metals. The number of calibration points required can be greatly reduced by employing what is termed a "standard reference table," which is simply a complete calibration of an average instrument of the type in question. There will be published as Research Paper No. 530, in the Bureau of Standards Journal of Research for February, standard reference tables for the two types of instruments ordinarily used. By the use of these tables, measurements at only two temperatures are required to obtain a complete calibration up to 2,700° F.

PROPERTIES OF HIGH-PRESSURE STEAM

The pressures at which steam is generated from boiling water at any temperature between 100° and 374° C. (212° and 705° F.) has been re-measured accurately at the Bureau of Standards, thus making available to engineers more precise data for the solution of problems in the design of steam engines and boilers. Water boils at 100° C. (212° F.) when open to the air at standard barometric pressure of 14.7 lbs./in.². When confined in a steam boiler, the pressure goes up as the temperature is raised. At 374° C. the pressure reaches 3,200 pounds if the boiler will stand it, two hundred and eighteen times that at 100° C. Up to this point the steam pressure is always determined by the temperature while liquid water remains. Above this critical temperature there is no difference between the liquid and the steam. The behavior of the pressure of live steam with

changing temperature is a characteristic property which is of utmost importance to engineers. These new measurements establish reliable values covering the range from the normal boiling point to the critical pressure of 3,200 lbs./in.².

The experimental boiler used was specially designed and was made of a tough nonrusting steel containing chromium, nickel, and tungsten. It held about one-third quart and was heated electrically. The most accurate types of pressure gage and thermometers were used to insure reliability of the measured pressures and temperatures. The reason for these extreme refinements is that recent advance in the development of steam power has created a demand for more accurate knowledge of the properties of steam. By using a formula fitted to the experimental results, tables have been calculated for steam pressures which are believed to be reliable to within three one-hundredths of 1 per cent. This is one of several researches which are being conducted in this country and abroad in a cooperative effort to obtain concordant tables of steam properties for the practical use of engineers. The expense is being chiefly borne by the steam-power industries. The complete account of this work will be published as Research Paper No. 523 in the February number of the Bureau of Standards Journal of Research.

VAPOR LOCK

The computations of vapor handling capacities of the fuel systems in 50 automobiles on which vapor-lock data were obtained by the bureau have been completed. Using these values as a basis, it has been possible to evaluate, with considerable accuracy, the permissible vapor pressures for freedom from vapor lock in these cars when operated under a variety of conditions on diverse types of fuels. This analysis of the vapor-lock results indicates that changes in design of fuel-feed systems so as to increase the vapor-handling capacity may be very effective in increasing the freedom from vapor-lock troubles. This procedure has, however, the disadvantage that fuel economy is decreased at the same time so that it is preferable to confine most of the efforts in redesign toward lowering of the fuel-line temperatures. It is believed that a Reid vapor pressure limit of 8 pounds is satisfactory up to atmospheric temperatures of 37.7° C. (100° F.) and that a 12-pound

gasoline may be used satisfactorily up to atmospheric temperatures as high as 23.8° C. (75° F.). Further work is being undertaken to verify these limits for different types of gasoline.

The conclusions drawn from this analysis of the test data obtained in the vapor-lock road tests were incorporated in a paper entitled "The Vapor Handling Capacity of Automobile Fuel Systems," which was presented at the annual meeting of the Society of Automotive Engineers last month.

STABILITY OF GREASES

The bureau is conducting an investigation of the effect of temperature on the bleeding of greases. It has been found that the change in the amount of bleeding, with increase in temperature, varies markedly for different types of greases. Thus, in some cases the amount of bleeding will increase as the temperatures increase, while in other cases the reverse is true. Believing that hardening of the grease due to loss of moisture on heating might account for the decrease in the extent of bleeding with increased temperature, some special experiments were undertaken to determine whether this was actually the case. In these special experiments the greases were heated to the temperature of test and allowed to remain at that temperature for a given period of time, after which they were cooled. By comparison of the amount of bleeding before and after this heating process, it was concluded that loss of moisture may have some effect, but that more probably the grease sets with a different gel structure after heating, with resultant increase in hardness. Further work on this phenomena is under way.

EXTREME PRESSURE LUBRICANTS

Data on load-carrying capacity of lubricants have been obtained with the Timken machine at speeds from 150 to 950 r. p. m. and at temperatures from 25° to 125° C., using four extreme pressure lubricants. Similar information has been obtained on the modified Floyd machine at speeds from 100 to 1,300 r. p. m. and at temperatures from 25° to 125° C., using eight oils. From these data the following conclusions are indicated:

1. The load-carrying capacity of an extreme pressure lubricant tends to decrease as the rubbing speed increases.
2. The load-carrying capacity of an extreme pressure lubricant tends to decrease as the temperature increases.

3. The effects of speed and temperature differ with the particular lubricant and machine involved to such an extent that even the order of reading may be changed.

4. No set of operating conditions was found with the machines which would even rate the lubricants in the same order.

The information which has been obtained in the investigation of extreme pressure lubricants up to date was assembled in a paper entitled "The Load-Carrying Capacity of Extreme Pressure Lubricants," which was presented to the Society of Automotive Engineers at their annual meeting in January.

SYNTHESIS OF KAOLINITE AND DICKITE

In an effort to determine the stability relations of the kaolin minerals, dried alumina-silica hydrogels have been subjected to the action of water at high temperatures.

The hydrogel was made by adding Na_2SiO_3 solution to an equivalent quantity of AlCl_3 solution and adding NaOH solution to neutrality as measured by phenol red. A gel precipitated out which, after thorough washing and drying at 110° C., analyzed: Al_2O_3 , 39.4 per cent; SiO_2 , 46.1; H_2O , 16 (corresponding figures for $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ are 39.5 per cent, 46.6, 14). The product was isotropic under the microscope with index of refraction about 1.535, and completely amorphous as evidenced by absence of X-ray diffraction patterns.

When the hydrogel was heated in water in a steel bomb at 312° C. corresponding to 100 atmospheres' steam pressure for 163 hours, there resulted a crystalline doubly-refracting material with mean index of refraction about 1.56, which gave an X-ray diffraction pattern identical with that of kaolinite. When heated at 344° C. (150 atmospheres' steam pressure) for 162 hours there resulted a crystalline product, microscopically identical with that obtained above, but which gave an X-ray diffraction pattern identical with that of dickite.

Thus it seems that kaolinite is stable at lower temperatures than dickite and that the invariant point where both would exist together in equilibrium lies somewhere between 312° and 344° C.

Some geologists claim that kaolinite is the result of low temperature weathering processes and that dickite is formed by higher temperature hy-

drothermal processes. These results confirm this hypothesis. Nothing has yet been done with nacrite, the third of the kaolin minerals.

VOLUME CHANGES IN CERAMIC MATERIALS DUE TO WEATHERING

Forty-two months ago this study was undertaken in order to obtain some definite knowledge regarding the effect of weathering on the volume changes of ceramic materials. Representative samples of wall tile, terracotta, and dinner ware were selected for observations. Some samples of each kind were subjected to the autoclave test at the Columbus branch of the bureau. A similar group of samples was exposed to actual weathering, while another group was subjected to a moisture-saturated atmosphere.

At the end of the first year the increase in length of the samples exposed to the weather and to the damp atmosphere was approximately the same as had been obtained in the autoclave treatment.

Continued exposure of the samples to weathering and to the damp atmosphere showed a continued increase in length of the samples, as measured at the end of 2 years, 3 years, and 42 months. The results obtained after two years' exposure exceeded those obtained in the autoclave treatment, and then increased time of exposure has shown a further increase in length in all cases. The samples exposed to the damp atmosphere show a slightly greater increase in length than the samples exposed to the weather, with a few exceptions.

A typical example is that of sample of white semivitreous dinner ware of 9.6 per cent absorption. The autoclave treatment gave an increase of 0.07 per cent. At the end of 6 months the outdoor samples showed an increase of 0.06 per cent; at the end of a year, an increase of 0.07 per cent; in 2 years, 0.10 per cent; and in 3½ years, 0.24 per cent. The damp jar samples were about 0.01 per cent greater in each case.

INFLUENCE OF COMPOSITION OF FUSION PROPERTIES OF GROUND COAT ENAMELS

In preparing new and improved compositions of vitreous ("porcelain") enamels, or developing special compositions to meet unusual requirements, it is important for the enameler to know whether the new compositions he is studying can be fused onto the metal base easily or only with diffi-

culty. Several different tests to obtain that information are in use in various laboratories. An investigation was recently completed at the bureau, in which these different methods of test were compared, and in which the variation in fusibility resulting from systematic variation in composition of the enamels was also studied. The tests showed that: (a) Increasing the flint content and simultaneously reducing feldspar caused a moderate increase in fusion temperature. (b) Increasing boric oxide and simultaneously reducing sodium oxide caused a marked increase in fusion temperature, but not a uniform one. The increase for each percentage change in ingredients was larger when the content of sodium oxide was larger and smaller when the content of sodium oxide was smaller. (c) Some tests required more flow of the enamel samples than others. As the amount of flow involved increased, the change in end temperature for each percentage change in composition became more uniform. (d) Tests involving more flow of the enamel samples were completed at higher temperatures than those involving less flow. (e) More systematic comparisons of enamels could be made by measuring the heat treatment necessary to produce a given effect than by submitting all samples to the same treatment and distinguishing between them by the varying effect produced.

The complete report of this study will be published as Research Paper No. 524 in the February number of the Bureau of Standards Journal of Research.

THE THERMAL DILATATION OF REFRACTORIES UP TO 1,800° C.

During the past several years items have appeared in this bulletin relative to the thermal expansion of refractories up to 1,800° C. A summary is now given of the final report being prepared which covers all the materials studied.

The linear thermal expansion was measured of African chrome sand, Cuban, Grecian, Friable African, Rhodesian Imperial, Indian, and Turkish chrome ores; Austrian, Californian, and electrically fused magnesites; a periclase brick, a spinel brick; each of two different types of fire-clay bricks and fire clays; a Kentucky, Tennessee, and an English ball clay; Georgia kaolin and an English china clay; an 80 per cent alumina brick, artificial corundum, diaspore,

bauxite, five mullites, each of which was prepared from a different raw material; two zircon bricks and a furnace zirconium silicate; silicon carbide, a silica brick, and an insulating brick. Observations were made up to 1,800° C. if the refractoriness of the material permitted. All of the specimens were tested in both an oxidizing and a reducing atmosphere from room temperature to 1,000° C. With four exceptions the same specimen was tested for expansion a second time to determine the effect, if any, on this property when the material was reheated to a temperature considerably higher than in the preliminary heating preceding the first test. Petrographic analyses give information relative to the constitution of the materials before and after several heat treatments.

It was noted that:

1. No apparent differences in expansion were found between room temperature and 1,000° C. when the materials were tested in either a reducing or oxidizing atmosphere except in the case of the chrome ores, which showed an exceptionally high expansion between 700° and 1,000° C. under reducing conditions.

2. The magnesites show the greatest total expansion of the materials which had nearly a uniform expansion.

3. The zircons show the greatest irregularity in expansion after the first tests.

4. All materials show some change in total expansion in the second test when compared with that obtained in the first test, although in some instances the difference is small.

5. Nearly all of the materials decreased in weight during the tests, due to volatilization of one or more of the constituents. Such volatilized material condensed or sublimed in the upper tube of the set-up. In most cases this material was undoubtedly silica. Crystalline growths appeared on some of the specimens. At the end of the tests all chrome ores were covered with beads of metal, probably an alloy of iron and chromium.

FIRE TESTS OF GYPSUM LATH PARTITIONS

Several fire tests of partitions covered with plaster on gypsum lath have been conducted recently as a part of the general series of fire tests of framed partitions. The lath, three-eighths inch thick and consisting of a core of gypsum with outside paper facings, was applied in the form of 16

by 48 inch boards to both sides of 2 by 4 inch pine studs spaced 16 inches on centers. For two partitions the lath was perforated with $\frac{3}{4}$ -inch round holes spaced 4 inches on centers each way, as aid in obtaining a good key for the plaster.

The gypsum plaster was either neat fibered or sanded in the proportion 1 part plaster to 2 parts sand by weight, the thickness over the lath, inclusive of a white coat finish, being one-half inch. The partitions were 16 feet long and 10½ or 11 feet high and were tested in the large wall and partition furnace. The fire exposure was controlled according to established procedure, so that furnace temperatures near 1,550° F. were indicated one-half hour after the start of the test, 1700° F. at one hour, and 1,792° F. at one and one-half hours. Failure in wall and partition tests is determined by occurrence of an average temperature rise under asbestos pads on the unexposed side in excess of 250° F. above the initial or of 325° F. at any point, transmission of flame, or failure to support load. In the present tests a load of 30,550 pounds (358 lbs./in.² of wood stud) was applied to four of the partitions subjected to the fire-endurance tests. The other two were tested restrained within the frames in which they were built, one being subjected to a fire-endurance test and the other to a fire and hose stream test. In the latter test the partition was subjected to the fire test for one-half hour, after which a hose stream from a 1½-inch nozzle under a pressure of 30 lbs./in.² was applied for 2½ minutes to the side exposed to fire. The hose stream washed off the plaster on the exposed side that had not fallen during the fire exposure, as also the lath, but did not penetrate the facing on the unexposed side of the partition.

The results of the fire endurance tests are given below:

Lath	Plaster	Time to failure
		Hr. Min.
Plain.....	{Neat fibered.....	0 58
	{Sanded 1:2.....	0 55
Perforated.....	...do.....	1 28

Failure was due either to inability to sustain load or to temperature transmission, the one occurrence following the other so closely in some tests as to make it difficult to determine which was the primary cause.

The 50 per cent increase in fire resistance with the perforated plaster board over those with the plain board can be ascribed to the better key for the plaster given by the perforations. Although perforated plaster board had been used experimentally as early as 1915 (Bureau of Standards Technologic Paper No. 70), it had not become commercially available until within the past year. The performance enables the partition construction employing this lath to qualify with a considerable margin on fire endurance for the 1-hour rating required for corridor and subdividing partitions according to some building codes. With the wood stud supports, its use would be restricted to locations in buildings where combustible constructions are permitted. Partition constructions have been developed employing plaster board applied to metal supports, but no fire tests with perforated plaster board or lath so applied have been made.

STORAGE OF GOVERNMENT RECORDS

In planning the National Archives Building, now under construction in Washington, every reasonable precaution is being included for the preservation of valuable Government records. At present there is no general depository for the records, and they are scattered through many buildings, exposed variously to danger of loss by fire, theft, and deteriorative influences.

In addition to the usual protective measures against loss through fire and other visible and well-recognized enemies, unusual precautions have been taken to guard against insidious enemies of paper and bindings, such as light, and air not properly tempered and purified. In planning the defense against such deteriorants of records, the recommendations of the bureau were followed. These are based upon an extensive study of the preservation of records in libraries conducted by the bureau with the assistance of funds granted by the Carnegie Foundation to the National Research Council.

While it has been generally known that light is not favorable to the preservation of paper, the bureau has shown that its destructive effect is more rapid and intense than commonly appreciated. In the Archives Building daylight will be entirely excluded from the storage spaces; small incandescent bulbs, turned on only as needed, will supply the necessary illumination.

A large air-treating system capable of handling 330,000 cubic feet of air

per minute will insure the purity and proper tempering of the atmosphere throughout the building. A new feature will be the washing of the air with an alkaline solution to remove positively any acidic contamination which might otherwise find its way into the storage space. The bureau's work has shown conclusively that acid gases, especially sulphur dioxide, widely produced by the combustion of fuels, accelerate the deterioration of all kinds of papers. The temperature and moisture content of the air will be carefully controlled, for high temperature and extreme dryness promote embrittlement of paper, while too much moisture may cause molding. It is planned to maintain a relative humidity of 55 per cent in the storage spaces and of 45 per cent in the workrooms. The latter condition is better adapted to human beings. The temperature throughout will be kept at 70° F. during the winter and 80° F. during the summer. The higher temperature during hot weather is more economical, and is more healthful for the personnel, as it avoids sudden exposure to too great a change in temperature in entering or leaving the building. Continuous maintenance of the humidity within 2.5 per cent and of the temperature within 1° above or below the chosen conditions is believed feasible.

Another interesting precaution is the use of glazed tile and the incasing of concrete columns in nonferrous metal to minimize abrasive dust. Coated or nonferrous metals will be used where metal is required in the storage spaces, to eliminate the necessity of repainting, which would be hazardous to the stored records.

This archives building can well serve as a model for the housing of valuable records of all kinds, since in planning it every advantage has been taken of the most advanced architectural, engineering, and scientific knowledge.

NEW CIRCULAR ON INKS

A publication of the bureau of considerable general interest, which has just been issued, is Circular C400 on Inks. This circular in part replaces an older publication, C95, and is an enlargement of a mimeographed letter circular LC331 prepared by the bureau last year, and which has had a wide distribution.

The present circular outlines briefly the history of iron gallotannate writing inks, gives formulas for three kinds of them, and has something to

say about the aging of writing and the restoration of faded writing. This is followed by short discussions of several other kinds of inks, including colored writing inks, drawing, stamp pad, recording, and other varieties.

Printing inks and others that depend upon pigments for their color and special properties are in a class by themselves. They are discussed in the circular, but no formulas for them are given.

The methods of testing provided for in the specifications under which the Federal Government purchases inks are described, and an appendix contains sections on weights and measures, equipment for making ink in the home, and on dyes suitable for a variety of inks. A brief bibliography is included.

Copies of the circular may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

PROPERTIES AND COATING QUALITY OF COMMERCIAL CASEIN

Why some makes of casein cause foam in applying clay coatings to paper is a mystery that must be solved before much progress can be made in efforts to increase the volume of production and value of domestic casein. This is the conclusion reached as a result of cooperative research by the Bureau of Dairy Industry and the Bureau of Standards.

The chief use of casein, which is briefly the washed and dried curd from soured milk, is as the adhesive for clay and other mineral coatings that form the excellent printing surfaces on paper intended for half-tone work and other high-grade printings. Mineral-coated paper is expensive, and considerable waste results if the casein is not of uniform and high quality. The Bureau of Dairy Industry is endeavoring to minimize waste in both the dairy and paper-coating industries by obtaining more exact knowledge of the essential coating properties and of the best ways to obtain them.

As a preliminary step, samples of representative domestic caseins were given exhaustive laboratory tests by the Bureau of Dairy Industry, and the services of the bureau were enlisted to secure experimental coating tests of the caseins in the paper mill. Finally, tests of the printing quality of the different coatings were made by the Government Printing Office.

The coating quality of the caseins, while generally good, was found to

vary considerably. But estimation of their coating quality by laboratory tests appears to be an elusive matter, for, although all of the tests commonly used by paper coaters and several in addition were employed, neither the chemical nor the physical properties tested bore much relation to the major differences in coating quality found. The chief defect found in using the caseins was that some of them caused foam in the coating mixture of casein, clay, and water. Foam results in a mottled coating which is entirely unsuitable for use. Furthermore, foaming tendency apparently bore no relation to the method of making the casein or to the coating procedure employed. Another unexplained fact in this connection, which is utilized commercially and which occurred in these experiments, is that when caseins that cause foam are mixed with those that do not, the blend usually yields satisfactory coatings.

The need for suitable standards of quality for casein evidenced by the results of this study is reflected in responses to inquiries on the subject addressed to paper coaters, because for nearly every positive statement made by one paper coater there is a contradictory statement by another. Further effect is to be made to develop such standards, with particular attention to the chief stumbling block—the “why” of foamy casein.

NEW AND REVISED PUBLICATIONS ISSUED DURING JANUARY, 1933

Journal of Research¹

Bureau of Standards Journal of Research, vol. 10, No. 1, January, 1933 (RP Nos. 512 to 521, inclusive). Price, 25 cents. Obtainable by subscription.

Research Papers¹

(Reprints from Journal of Research)

RP494. Nitrogen content of some standard-sample steels; J. G. Thompson and E. H. Hamilton. Price, 5 cents.

¹ Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to TECHNICAL NEWS BULLETIN, 50 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 70 cents. Subscription to Journal of Research, \$2.50 per year; other countries, \$3.25. Subscription to Commercial Standards Monthly, \$1 per year; other countries, \$1.60.

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RP495. Analytical methods for the determination of levulose in crude products; R. F. Jackson, J. A. Mathews, and W. D. Chase. Price, 5 cents.

RP496. Determination of alumina and silica in steel by the hydrochloric acid residue method; J. G. Thompson and J. S. Acken. Price, 5 cents.

RP497. An analysis of lanthanum spectra (La I, La II, La III); H. N. Russell and W. F. Meggers. Price, 10 cents.

RP498. Analysis of weighted silk; R. T. Mease. Price, 5 cents.

RP498. The heat of formation of hydrogen chloride and some related thermodynamic data; F. D. Rossini. Price, 5 cents.

RP500. Thermal expansion of lead; P. Hidnert and W. T. Sweeney. Price, 5 cents.

Simplified Practice Recommendations¹

R134-32. Singletrees, doubletrees, and neckyokes. Price, 5 cents.

R135-32. Wooden butter tubs. Price, 5 cents.

Commercial Standards¹

CS42-32. Fiber insulating board. Price, 5 cents.

Commercial Standards Monthly¹

Commercial Standards Monthly, vol. 9, No. 7, January, 1933. Price, 10 cents. Obtainable by subscription.

Technical News Bulletin¹

Technical News Bulletin No. 189, January, 1933. Price, 5 cents. Obtainable by subscription.

LETTER CIRCULARS

It is the intent of the bureau to distribute single copies of these mimeographed letter circulars on request only to those parties having a special interest in the individual letter circu-

lar. Economy necessitates limitation in the number of copies issued. It is not the intent to supply parties with a copy of each letter circular issued during the month. Letter circulars are necessarily of a temporary nature designed to answer numerous inquiries on a given subject. Requests should be addressed to the Bureau of Standards, Washington, D. C.

LC351. Color and legibility. (Sources of information and summary of results to be found in the literature on this subject.)

LC352. Color of illuminant and efficiency of worker. (Sources of information and summary of results to be found in the literature on this subject.)

LC353. Railroad track scale testing service of the National Bureau of Standards, fiscal year July 1, 1931, to June 30, 1932.

LC354. List of available commercial standards.

LC355. Key to minimum requirements recommended by the Department of Commerce Building Code Committee.

LC356. Color harmony. (Summary of the opinions of the various authorities on this subject.)

LC357. Real estate appraisal practices.

OUTSIDE PUBLICATIONS²

Brooks, H. B., Les potentiometres, Congres International d'Electricite (Paris, France), second edition, report No. 14; 1932.

Gould, R. E., Telling time by moving shadow, United States Daily (Washington, D. C.), vol. 7, No. 263, p. 8; February 6, 1933.

Hidnert, Peter, and Krider, H. S., Thermal expansion of antimony, Physical Review (Corning, N. Y.), vol. 42, p. 911; December 15, 1932.

Stevens, F. W., The gaseous explosive reaction at constant pressure—Further data on the effect of inert gases. National Advisory Committee for Aeronautics (Washington, D. C.), Technical Note No. 438; December, 1932.

Scherrer, J. A., Rubber beaker rings for accelerating evaporation on the steam bath, Industrial and Engineering Chemistry, Analytical Edition (Washington, D. C.), vol. 5, p. 22; January, 1933.

¹ Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to TECHNICAL NEWS BULLETIN, 50 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 70 cents. Subscription to Journal of Research, \$2.50 per year; other countries, \$3.25. Subscription to Commercial Standards Monthly, \$1 per year; other countries, \$1.60.

² "Outside publications" are not for distribution or sale by the Government. Requests should be sent direct to publishers.

- Heald, R. H., Rolling, yawing, and hinge moments, produced by rectangular ailerons, National Advisory Committee for Aeronautics (Washington, D. C.), Technical Note No. 441, January, 1933.
- Dryden, H. L., Structural resistance to wind, United States Daily (Washington, D. C.), vol. 7, No. 248, p. 8; January 16, 1933.
- Whittemore, H. L.:
 Use of welding to join parts of pre-fabricated metal home, United States Daily (Washington, D. C.), vol. 7, No. 251, p. 8; January 19, 1933.
- Progress in shop fabrication of dwellings, United States Daily (Washington, D. C.), vol. 7, No. 258, p. 8; January 30, 1933.
- Standard structural elements of frame buildings, United States Daily (Washington, D. C.), vol. 7, No. 263, p. 8; February 6, 1933.
- Insley, Herbert, Minerals with the composition $Al_2O_3 \cdot SiO_2$, Journal, American Ceramic Society (Columbus, Ohio), vol. 16, No. 1, p. 58; January, 1933.
- Heindl, R. A., Pendergast, W. L., and Mong, L. E. Kaolins, Effect of firing temperature on some of their physical properties, Journal, American Ceramic Society (Columbus, Ohio), vol. 16, No. 1, p. 75; January, 1933.
- Geller, R. F., Effect of repeated heatings on the mechanical strength of high-tension insulator porcelains, Bulletin of the American Ceramic Society (Columbus, Ohio), vol. 12, No. 1, p. 18; January, 1933.
- McAllister, A. S., How can the results of Federal testing be made available to State governments and divisions thereof? Educational Business Manager and Buyer (Chicago, Ill.), January, 1933.
- Fairchild, I. J., Quality standards for products to meet consumer's demand, United States Daily (Washington, D. C.), vol. 7, No. 252, p. 8; January 20, 1933.
- Briggs, Lyman J., Report for 1932 on work of astronomical interest at the Bureau of Standards, Publications of the American Astronomical Society (Princeton, N. J.), vol. 7, No. 4, p. 127; December, 1932.

U. S. DEPARTMENT OF COMMERCE

TECHNICAL NEWS BULLETIN

OF THE

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INTERNATIONAL ACTION ON UNITS IN ELECTRICITY AND LIGHT

The Advisory Committee on Electricity and Photometry, established by the International Committee on Weights and Measures, held its third biennial meeting at Paris, January 31 to February 3. The committee consists of representatives of France, Germany, Great Britain, Italy, Japan, the United States, and the U. S. S. R. (Russia). All except the Russian representative attended this meeting. Specially invited experts from Holland were also present, as well as representatives of the International Bureau of Weights and Measures and of the International Commission on Illumination.

As was stated in Technical News Bulletin No. 190 (February, 1933), the principal purpose of this meeting was to fix dates on which new units in electricity and light might be internationally accepted for general use, and to make a definite plan for the comparisons and interchange of standards which will be necessary to assure uniformity of values among the different countries.

The conclusions reached are subject to ratification by the International Committee on Weights and Measures, and on some matters of principle it is considered necessary to obtain also the approval of the general conference of 32 nations, which is the ultimate authority. Both of these bodies meet in the fall of 1933.

The authority of the international committee to take up photometry under the terms of the existing treaty has been questioned, and the appointment of a single advisory committee to deal with this subject as an adjunct of electricity has been criticized. Consequently it is proposed to ask the general conference to authorize the appointment of a separate advisory committee on photometry. In the meantime, however, the present committee has collaborated with a special committee on units and standards appointed by the International Commission on Illumination, and consisting of representatives from the national committees on illumination in France, Germany, Great Britain, Holland, Japan, and the United States. With the advice of this group of specialists, considerable progress was made at